# B07 Guided Interpretation #7: Formation testers

This example gives an overview of the Formation testers module. The objective of this session is to learn how to load and process data from formation tests and the results of their interpretation (i.e. discrete values of reservoir pressure, and mobility or permeability).

## B07.1• Loading the data

### B07.1.1 • Formation tests specific data types and mnemonics

Calling the Formation testers option amounts to creating a specific object in the data hierarchy, below the Survey level. A Formation Testers object comprises a number of channels, for the reservoir pressure, mobility, and permeability. Specific data types in the Emeraude database are:

| Data Type | Default built-in mnemonic | Units |
|---|---|---|
| Formation pressure | RESP | Pa, kPa, psia, psig, atm, bara, barg, kg/cm2, m |
| Formation mobility | RESM | md/Pa.sec, md/cp, Darcy/Pa.sec, Darcy/cp, m2/Pa.sec, m2/cp, cm2/Pa.sec, cm2/cp, µm2/Pa.sec, µm2/cp |
| Formation permeability | RESK | md, Darcy, m2, cm2, or µm2 |

Fig B07.1

### B07.1.2 • Loading

Start Emeraude, create a new document, a new survey and load the data from the file B07ft.las. This file contains the following curves: Wellbore Temperature and Pressure, Reservoir Pressure, and Reservoir Mobility.

*Remarks: Although formation tests data are acquired as stationary measurements, all depths of interest should be loaded in one go, i.e. do not load the data as multiple discrete stations, but as a versus depth information. You could load from distinct sources; for instance the wellbore pressure vs. depth could be in one file, and the reservoir mobility (or permeability) and reservoir pressure vs. depth in another one.*

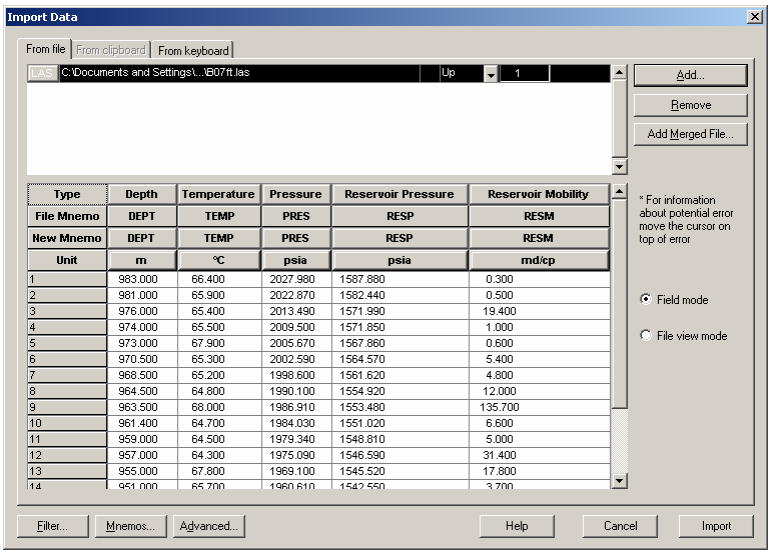



Fig B07.2 Loading Data

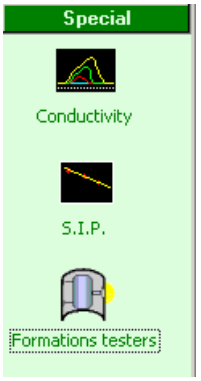
Accept the default mnemonics and units and import the data.

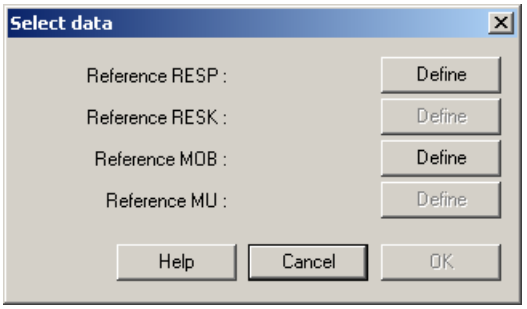
Wellbore temperature and pressure log channel are generated automatically after loading; you will see later in this session how the reservoir pressure and mobility are displayed once they are defined within the “Formation Testers” analysis. Hide the Pressure and Temperature log channel views and go to the special control panel.

## B07.2 • Creating the FT analysis

### B07.2.1 • Calling the FT option

When the survey contains at least a "Formation permeability" or a "Formation mobility", AND a "Formation pressure", the "Formation testers" option of the Special panel is enabled. Click on this option, and access the dialog below to select the input data:



### B07.2.2 • Defining the reference channels

The "Define" buttons are used to select the desired channels. They open a selective data browser indicating only the candidate locations/channels. Those options/dialogs can be used to select or unselect. Define the reference pressure and mobility by selecting the candidates from the “Search” dialogs as shown in Fig B07.3 below:

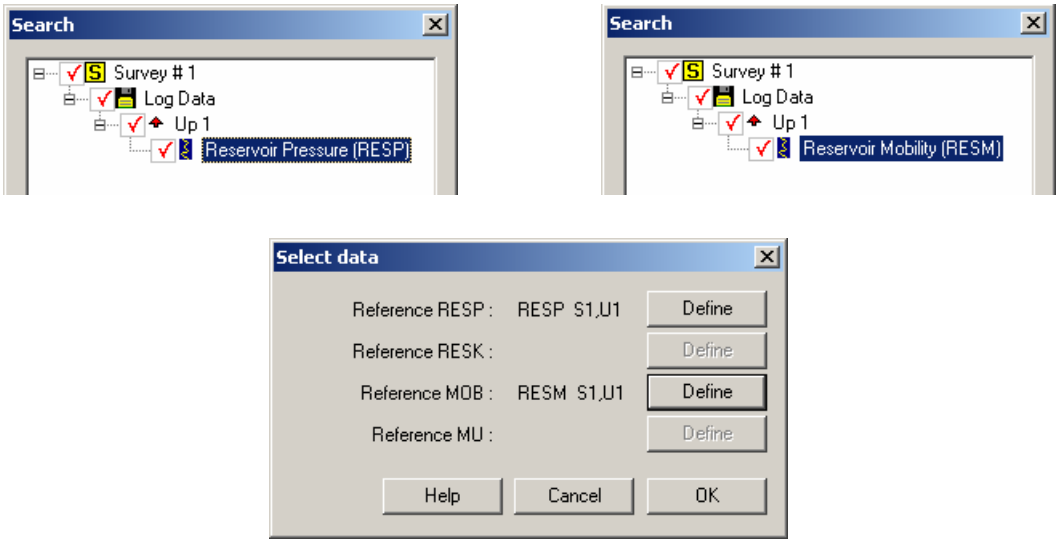



Fig B07.3 Selecting reference channels

### B07.2.3 • Formation testers main dialog

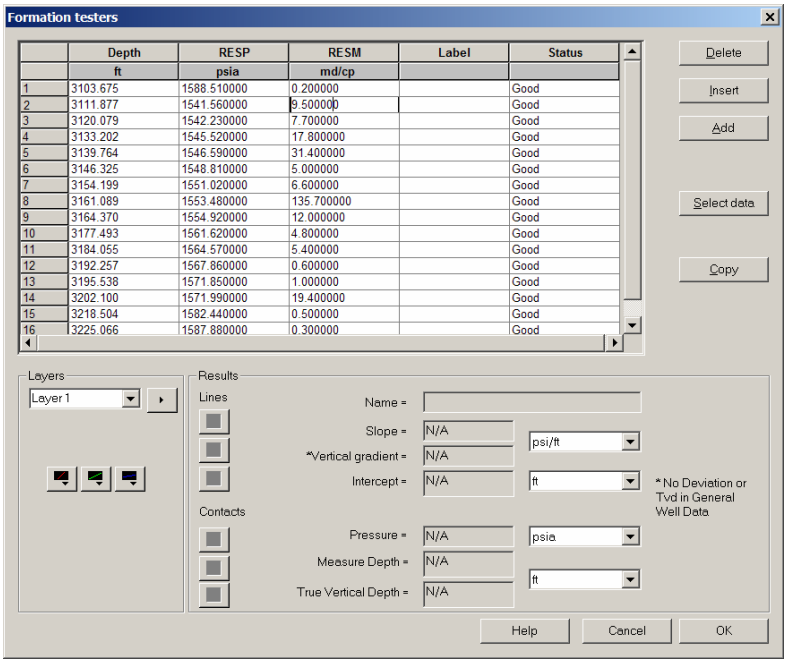



Fig B07.4 Formation Testers main dialog

Once the channels have been selected, the above main dialog is automatically displayed. It shows a grid summarizing the information associated with each of the formation pressure tests:

- Depth, Reservoir pressure, and Reservoir Mobility values (those values are editable).
- The “Label” column can be used to assign a label to each point (“Normal” – “Supercharged” – “Dry” can be accessed with a right click, or anything else can be typed in directly).
- The “Status” column is also included and the content of the cells can be changed by repeated clicks between “Good” – “Medium” – “Bad”.

Under the data browser, a new node has been created and materializes the Formation Testers Analysis that contains the previously defined reference channels RESP and RESM – see opposite.

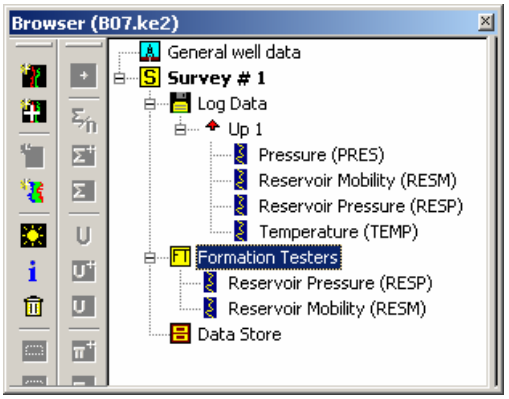



Fig B07.5 Formation Testers Node

You can enter labels the labels and change the status according to Table B07.6 below. Note you can select several cells together, and then right click to access the desired label/status for all of them. Also, a single click in the Status œlls will change the content.

| | Depth, ft | RESP, psia | RESM, md/cp | Label | Status |
|---|---|---|---|---|---|
| 1 | 3103.67 | 1588.51 | 0.2 | Supercharged | Bad |
| 2 | 3111.87 | 1541.56 | 9.5 | Normal | Good |
| 3 | 3120.07 | 1542.23 | 7.7 | Normal | Good |
| 4 | 3133.20 | 1545.52 | 17.8 | Normal | Good |
| 5 | 3139.76 | 1546.59 | 31.4 | Normal | Good |
| 6 | 3146.32 | 1548.81 | 5 | Normal | Good |
| 7 | 3154.19 | 1551.02 | 6.6 | Normal | Good |
| 8 | 3161.08 | 1553.48 | 135.7 | Normal | Good |
| 9 | 3164.37 | 1554.92 | 12 | Normal | Good |
| 10 | 3177.49 | 1561.62 | 4.8 | Normal | Good |
| 11 | 3184.05 | 1564.57 | 5.4 | Normal | Good |
| 12 | 3192.25 | 1567.86 | 0.6 | Normal | Good |
| 13 | 3195.53 | 1571.85 | 1 | Supercharged | Bad |
| 14 | 3202.10 | 1571.99 | 19.4 | Normal | Good |
| 15 | 3218.50 | 1582.44 | 0.5 | Supercharged | Bad |
| 16 | 3225.06 | 1587.88 | 0.3 | Supercharged | Bad |

Table B07.6 Assigning Label and Status

### B07.2.4 • Plotting

The Formation testers option automatically creates views to display the reservoir permeability/mobility and pressure. On this views the channels appear with markers, with their label, and each point is displayed with a color representative of its status (green=good, orange=medium, red=bad). The reservoir pressure is displayed on a standard linear scale while the reservoir permeability/mobility track view has a logarithmic scale.

Exit the “Formation testers” dialog with OK, and organize (Tile) the Emeraude main display as in the figure below:

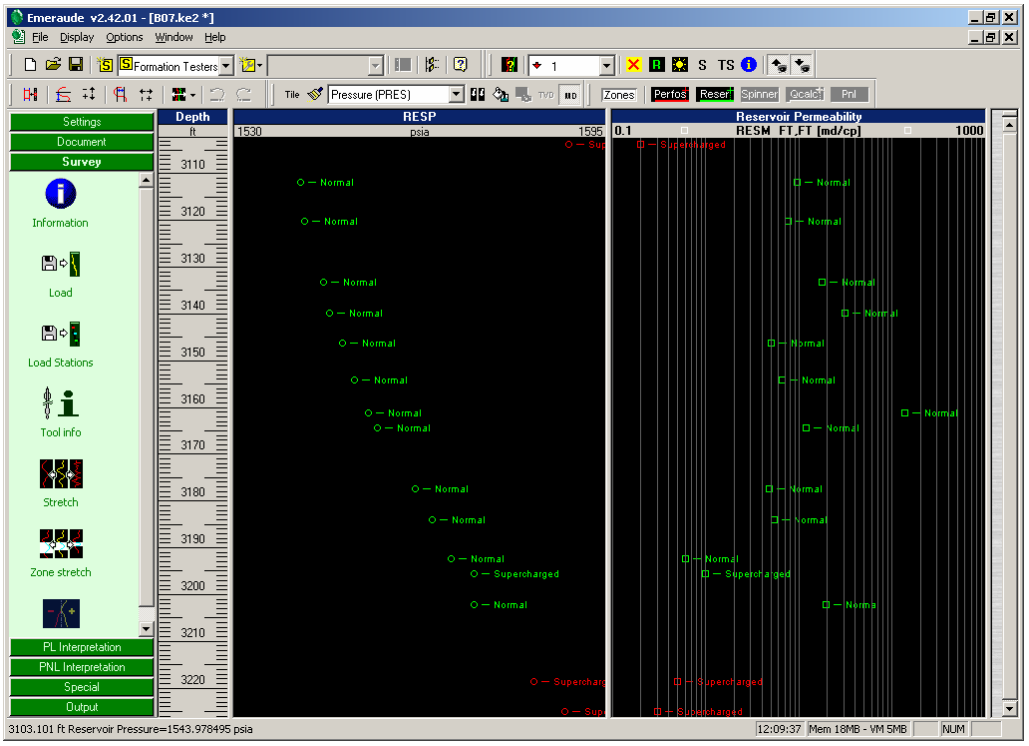



Fig B07.7 Formation testers plots

If the survey contains others permeability/mobility channels, they will also appear on the view as seen in Fig B07.8 (white curve). From the survey control panel, open the “Load” option and import the “B07oh.las”. This file includes a permeability curve from a previous open-hole logging session. This curve appears on the same track as the loaded mobility curve.

Reset the permeability curve horizontal scale from 1 to 10000 in order to show the logarithmic scale vertical lines (the same number of decades is required for both channels for the scales to be compatible).

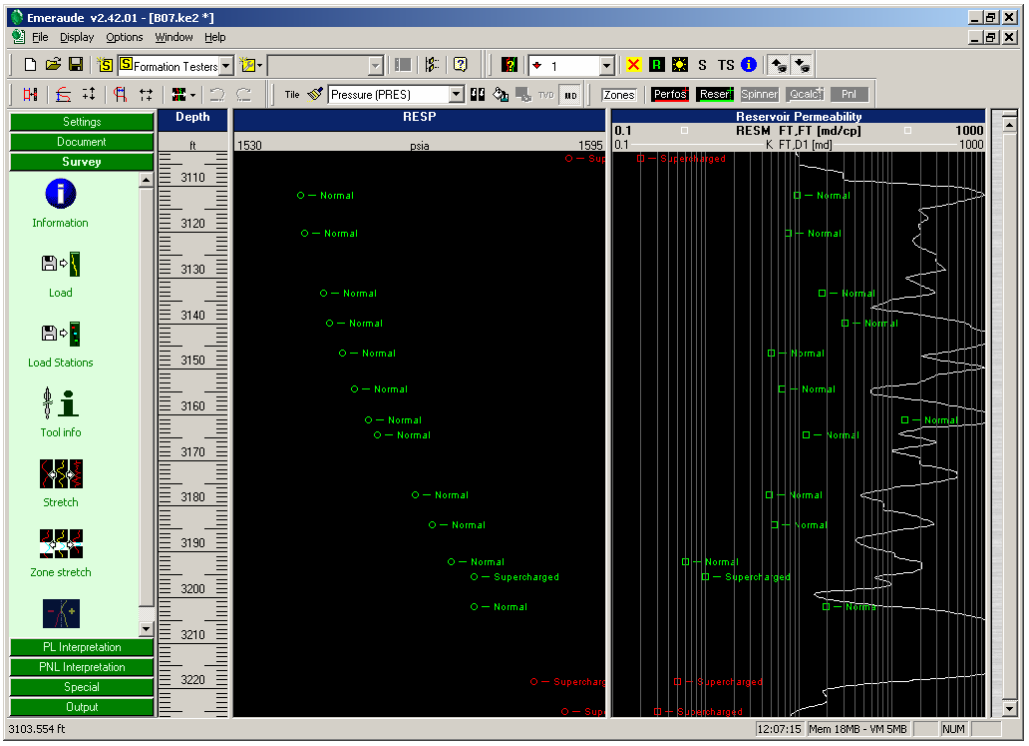
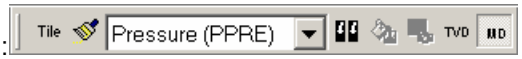


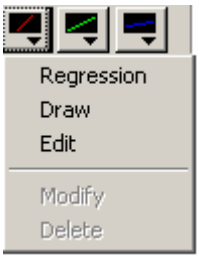

Fig B07.8 Formation testers plots and Open-hole permeability

### B07.2.3 • Defining the gradients and contacts

Go back to the “Formation testers” main dialog. Once the linearities have been decided on the screen, it is possible to create lines, by least square, or by drawing on the reservoir pressure view. Provision has been made for an unlimited number of layers, and within each layer for three lines representative of water, oil, and gas. In this session, it is assumed that the well is vertical and therefore we do not worry about deviation/TVD. If the well was deviated, and with loaded data supplied versus MD, you should load a TVD channel in the General Well Data (using the Load Well Data option of the Document panel). Once the TVD channel is loaded, the display can be dynamically switched to TVD using the last 2 icons of the Display toolbar:




At startup, only one layer is created but you can add as many as required clicking on the button next to the layer drop list. For a given layer, the 3 lines for gas, oil, and water are created, modified, or deleted using the corresponding buttons as seen in opposite.




When selecting “Regression” “Draw” or “Modify”, the dialog is hidden and the operation is conducted directly on the formation pressure view as follows:

- Regression: click for the first limit, drag, and then release for the second limit. After the range is selected a dialog pops up that gives the option to either select all the points, the good only, or the good + medium only.
- Draw: click for the start point of the line, drag and then release for the end point.
- Modify: a central cursor can be seized that moves the line up and down. At each extremity, two more cursors can be grabbed to rotate the line.

In order to define the gas pressure gradient, pick the red line icon and select the regression option; compute the line from 3103m to 3135m:

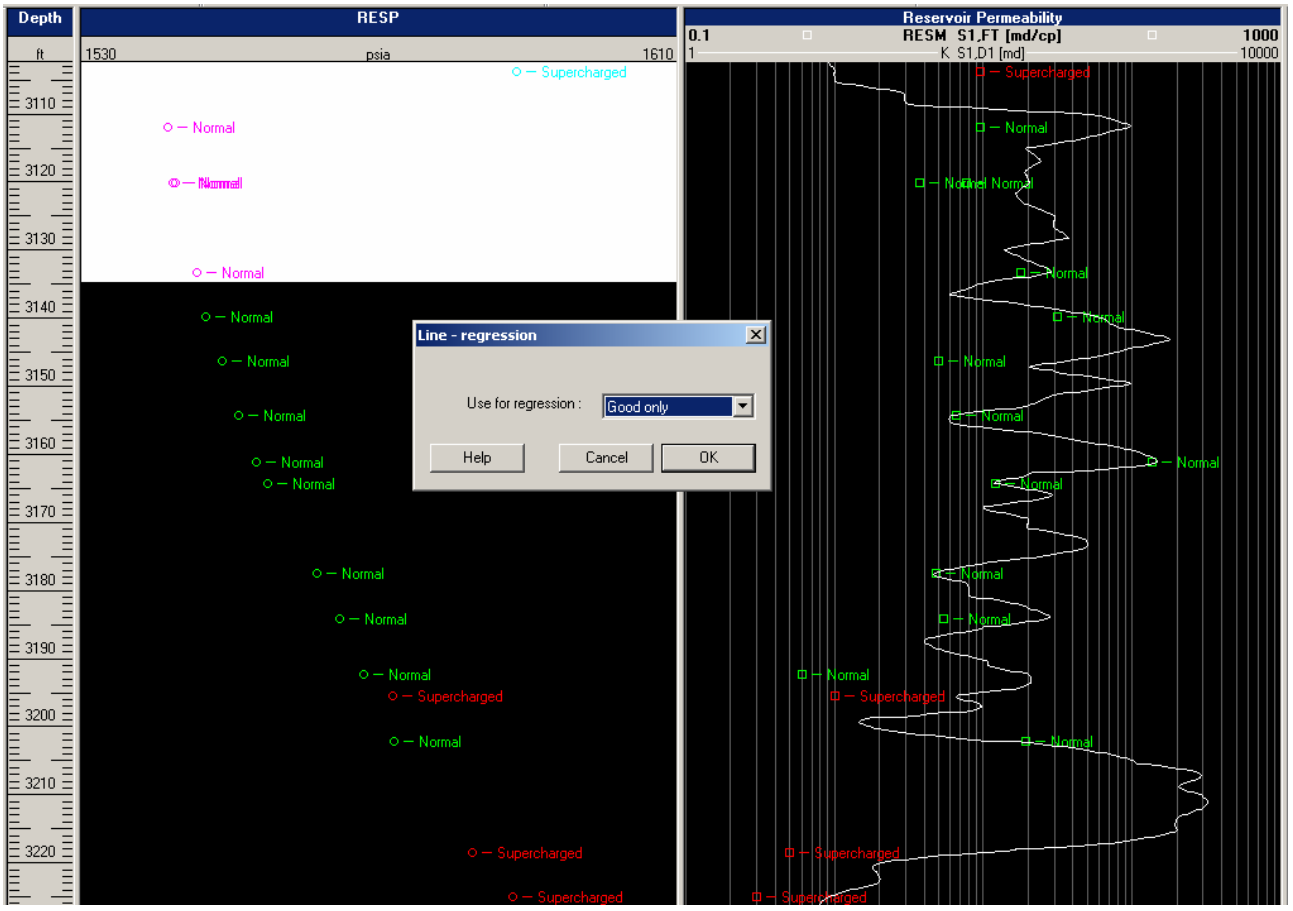
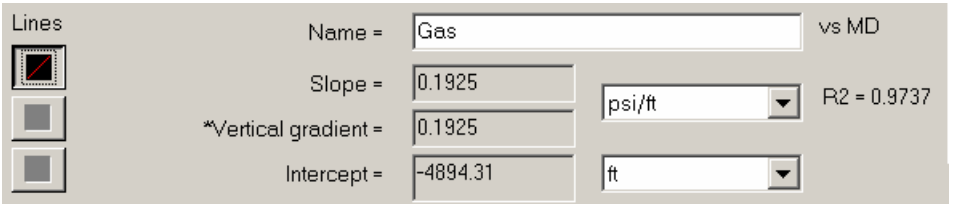



Fig B07.9 ; Defining the gas gradient

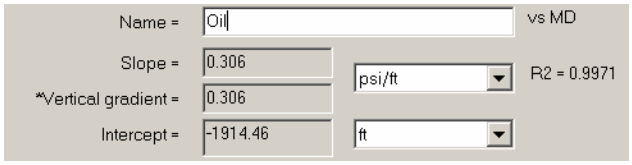
Select the “good only” points and exit with OK. The “Formation testers” dialog pops up back on the screen and a red line corresponding to the computed gradient is being drawn. The results are seen in the lower part of the dialog, with a section where a name can be given to the line. Type in “Gas”, as seen below.

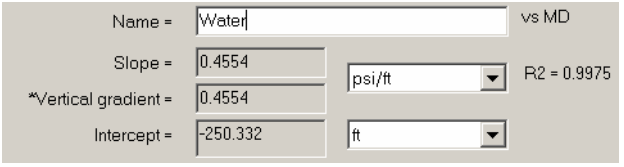


Next to the line name is the indication of the scale where the line was created (MD or TVD). The slope is the actual slope on the line native scale. The vertical gradient is either the slope, if the line is created versus TVD, or the actual slope divided by the cosine of the average deviation in the line interval otherwise. Once again, let us insist on the fact that if the deviation is significant and not constant, you should load a TVD channel in the General Well Data, and toggle the display to TVD before defining the lines.
For a line defined by regression, R2, the determination coefficient is displayed. Recall that a value of 1 is indicative of a good fit, whereas 0 is the opposite. To change the line, you can select among the following options:

- Edit and change the slope/intercept values directly. This option is enabled only if the display mode (TVD or MD) is the mode where the line was created.
- Modify the line interactively,
- Delete the current line and re-perform a Regression/Draw action.

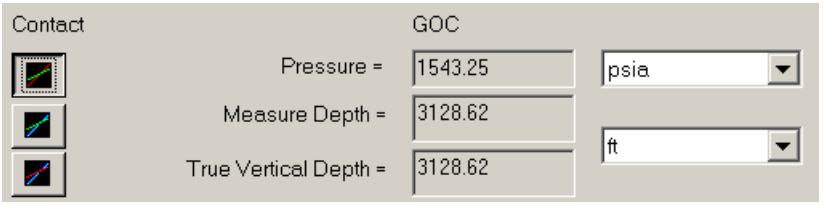
Use the Regression option to compute the oil line -green- (from 3135m to 3160m) ; and the water line –blue- (from 3160m to 3210m) in a similar manner. Selecting the “Good only” points for all lines should lead you to the following results:



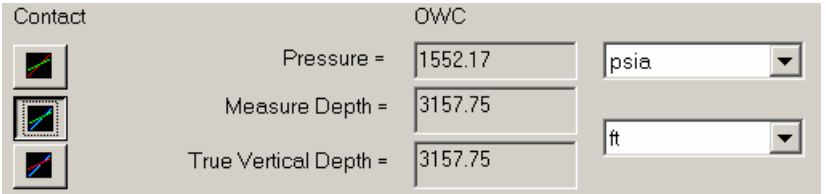




Once at least two lines have been defined (on the same scale), Emeraude will automatically compute their intersection and display the results under the “Contacts” section:

**O**il **G**as **C**ontact:




**W**ater **O**il **C**ontact:



Annotations are automatically created to display the pressure gradient for each line and contact depth values on the reservoir pressure view. Those annotations are moveable as seen in Fig B07.10:

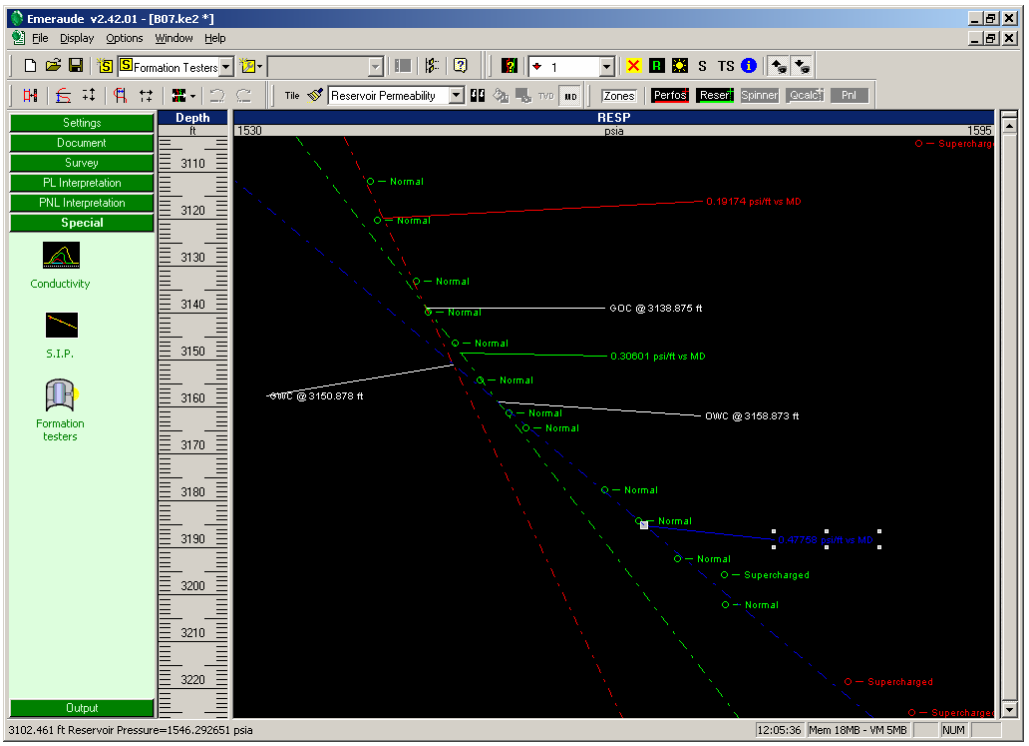



Fig B07.10 Gradient lines and Contacts

*This concludes Guided Interpretation#7*